

## TABLEWARE-WASHING PROCESS INCLUDING A BIOCIDES

**Field of the Invention**

- 5 This invention relates to a ware washing process. More particularly, but not exclusively, this invention relates to a ware washing process that is conducted in the presence of a biocide.

**Background to the Invention**

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In this specification, the use of the word "ware" means items which are used in the preparation and consumption of food and drink, including, but not limited to items such as cutlery, crockery, pots, pans and tableware.

- 15 The success of conventional ware washing processes and the associated use of conventional detergents tends to be found in their removal of common food soils under alkaline conditions, using inorganic alkalis. While these processes remove a large number of fats, proteins and sugars, due to the solubility of such soils in water, it is well documented that these soils lend themselves,
- 20 primarily, to removal under warm or even hot conditions. Industrial and household auto ware washing is presently, conventionally a warm water multi-stage process, including a prewash stage (typically conducted at temperatures of 35°C – 40°C and wherein bulk soils are removed from the ware), a detergent wash stage (typically conducted at temperatures of 55°C –
- 25 65°C and wherein the ware is washed with a detergent) and a rinse stage (typically conducted at temperatures of approximately 85°C and wherein the ware are rinsed so as to remove any residual detergent thereon). The current practice requires operation of washing machines at these relatively high temperatures in order to ensure, first, the breaking of chemical and/or physical
- 30 bonds between the soils and the item to be washed and, second, the precipitating out of solution of those soils via a chelation or sequestration process.

A disadvantage of conventional warm water washing is the increased energy-consumption associated with generating hot water, as well as the increased down-time and maintenance of washing machine components, including boilers and elements, that is required, relative to cold-wash machines.

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In this specification, the term "warm water washing" means washing at temperatures above 35°C, typically in the range 35°C – 85°C, while the analogous term "cold water washing" means washing at temperatures below 35°C, typically in the range 10°C – 25°C.

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Another disadvantage associated with warm water washing processes is the fact that they tend to generate relatively hot to humid conditions in the machine, which conditions are conducive to the sustainability of various forms of bio organisms such as bacteria, algae, fungi and moulds. These same conditions also create a habitable environment that is favoured by pests such as cockroaches. Accordingly, warm water warewashing processes tend to lend themselves to at least some objectionable, unhygienic consequences.

The use of biocides, such as ozone, in a warm water washing process is known in order to overcome the above problems. The ozone is typically bubbled through water held in the re-circulating or wash tank of a ware washing machine. One of the disadvantages is that an insufficient amount of ozone is infused into the water so as to completely destroy all the bacteria on the ware in the ware washer.

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### **Object of the Invention**

It is an object of the invention to provide an alternative ware washing process, that, it is believed, will overcome or at least minimize the disadvantages and difficulties with the prior art as set out above.

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## Summary of the Invention

According to the present invention there is provided a ware washing process  
5 including the steps of:

- (i) washing ware in a washing cavity of a ware washer with water and a ware washing detergent;
- (ii) rinsing the ware in the ware washer with water; and
- 10 (iii) introducing a biocide into the washing cavity of the ware washer in order to provide a gaseous atmosphere thereof in the washing cavity, the biocide being introduced into the washing cavity prior to or contemporaneously with or subsequently to the washing or rinsing of the ware.

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The water may be at a temperature below 35°C, preferably between 10°C to 25°C. The biocide may be introduced into the washing cavity in gaseous phase.

20 In a preferred embodiment of the invention, the biocide is introduced into the washing cavity of the ware washer independently of the water. Preferably, the biocide is ozone.

In one embodiment of the invention, the ozone is dosed into the washing  
25 cavity in the gaseous phase at a rate of 500 to 900 mg/hr, preferably at 780 mg/hour.

The ozone is preferably generated by means of an ozone generator having an ozone outlet in fluid flow communication with the washing cavity.

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In one embodiment of the invention, the biocide may be introduced into the washing cavity at a temperature in the range of 15°C to 25°C. Furthermore, the biocide may be introduced into the cavity at a pH of between 2 and 12.

In one embodiment of the invention, a pre-rinse stage may be introduced prior to washing the ware, the pre-rinse stage being used to remove bulk soil from the ware using water only. During the step of pre-rinsing, the biocide may be introduced into the washing cavity at a pH of between 4 and 6.

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In another embodiment of the invention, water used in the process and exposed to the biocide may be recycled. It will be appreciated that where the biocide is ozone the water exposed thereto may be ozone infused water.

- 10 The ware washing detergent may include an inorganic alkali, a complexing agent and at least one surfactant.

- In a preferred embodiment of the invention, a caustic alkali is used. Preferably the caustic alkali is selected from the class of compounds selected from the group consisting of alkali metal hydroxides. More preferably the inorganic caustic alkali may be sodium hydroxide or potassium hydroxide.

- The complexing agent may be a compound selected from the group consisting of a phosphate, an amino carboxylic acid, nitrolo triacetic acid (NTA), ethylenediamine tetra-acetic acid (EDTA), a phosphonic acid, a phosphonobutone, an acrylate and any combination thereof. In a preferred embodiment of the invention, two complexing agents are used, namely EDTA and NTA.

- 25 In an embodiment of the invention, the at least one surfactant may be selected from the group consisting of anionic or non-ionic surfactants.

- Preferably the ware washing detergent composition comprises a mixture of surfactants, preferably a mixture including alkyl polyglucoside (for example Triton BG-10 ) and alkylamino polyethoxy polypropoxy propanol (for example Triton CF-32).

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The ware washing detergent may include between 0.1% – 55% (m/m) of the inorganic alkali, between 0.1% – 45% (m/m) of the complexing agent, and between 0.05 – 20% (m/m) of surfactant.

- 5 Additives may also be included in the ware washing detergent, for example anti scaling agents and/or coupling agents. In one embodiment of the invention the anti scaling agent used is Bayhibit™ AM or Belclene® 650 which are trade names for products in which the active ingredient is 2 phosphono-butane 1,2,4 tricarboxylic acid. The coupling agent is preferably caustic soda lye.
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In a preferred embodiment of the invention, the ware washing detergent comprises:

Component	% composition (by mass)
EDTA	4.00
NTA	7.00
Caustic soda lye	40.05
Water (softened)	46.70886
Triton BG-10	0.06615
Triton CF-32	0.08976
Bayhibit™ AM or Belclene® 650	0.01963
Water (softened)	2.0656

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In a further embodiment of the invention, the step of rinsing the wares, that is step (ii) above, may include the use of a rinse aid composition which may comprise one or more alkoxyated alcohols; and an acid.

- 20 The rinse aid composition may include between 0.1% to 90% (m/m) of alkoxyated alcohol, and between 0.1% to 25% (m/m) of acid.

The chain length of the alkoxyated alcohol may be varied between C<sub>4</sub> to C<sub>22</sub>.

In one embodiment of the invention the alkoxyated alcohol may comprise an ethoxylated alcohol and the degree of ethoxylation of the ethoxylated alcohol may be varied between 1 mole to 30 mole ethylene oxide.

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In a preferred embodiment of the invention a mixture of alkoxyated alcohols is used, the mixture comprising alkoxyated alcohols known in the trade as Synperonic™ LF/RA30 and Synperonic™ LF/RA260.

- 10 Preferably, the mixture of the alkoxyated alcohols is 100% active with the cloud point of a 1% solution of the alkoxyated alcohol in water, at a temperature of less than 22°C.

- 15 The acid may be an organic acid and may be selected from the group consisting of citric acid, acetic acid, sulfamic acid, phosphoric acid and any combination thereof. Preferably the acid is citric acid.

In a preferred embodiment of the invention, the rinse aid composition comprises:

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Component	% composition (by mass)
Propyl alcohol	40.00
Citric Acid	0.10
Water (softened)	49.40
Synperonic™ LF/RA30	5.50
Synperonic™ LF/RA260	5.00

In a preferred embodiment of the invention, the rinse aid composition may further include a dye.

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According to a second aspect of the invention there is provided the use of a biocide in a ware washing process, the biocide being introduced into a

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washing cavity of a ware washer so as to provide a gaseous atmosphere therein.

5 Preferably the biocide is introduced independently from the water used to wash ware located in the washing cavity. Preferably the biocide and its introduction into the washing cavity is as described above.

10 According to a third aspect of the invention, there is provided a ware washer having a washing cavity, the ware washer including introduction means for introducing biocide into the washing cavity so as to provide a gaseous atmosphere thereof within the washing cavity. In a preferred embodiment of the invention, and where the biocide is ozone, the introduction means comprises an ozone generator, having an ozone outlet in fluid communication with the washing cavity.

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The biocide introduction means may be separate from the means for introducing water into the washing cavity. The washing cavity may be accessed by means of a door and may be configured to receive ware therein.

20 It will be appreciated that the ware washer will be in fluid flow communication with a source of water and will have a water inlet, wherein water is introduced into the washing cavity, and a water outlet, wherein dirty water is disposed of. In an embodiment of the invention, biocide infused water may be recycled by means of a recycling system.

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In one embodiment of the invention, the ware washer also includes means for introducing a ware washing detergent and/or a rinse aid composition into the washing cavity.

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## Detailed Description of the Invention

Without limiting the scope of the invention and by means of example only, an embodiment of the invention will now be described and exemplified with reference to the accompanying figure.

Figure 1: is a cross sectional side view of the ware washer used in the ware washing process according to the invention.

### Example 1: Experimental Procedure for the Determination of the Efficacy of Ozone as a Biocide in Ware Washing

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Each Formulation was evaluated using a Hobart F25 ware washer.

More particularly, the Hobart F25 ware washer (10) used had been modified (not shown) by disconnecting the heating elements so that the ware washing process could only be carried out at ambient temperatures within the cold water washing range. The particular results discussed below were conducted and recorded at an ambient temperature of 17.4°C.

The ware washer (10) was further modified by including an ozone generator (15) having an ozone outlet (20) in fluid flow communication with a washing cavity (25) of the ware washer (10), so that ozone in gaseous phase could be introduced into the washing cavity (25) thereby to create an atmosphere of ozone therein. The washing cavity (25) can be accessed by means of a door (30) through which ware (32) may be loaded into the ware washer (10).

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It will be appreciated that the ware washer (10) is connected to a source of water (not shown) and has an inlet (35) for water and an outlet (40) for soiled water. The ware washer (10) also includes inlets (45) for introducing detergents and / or rinse aids into the washing cavity (25).

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The Hobart F25 ware washer was operated on a 6 minute ware washing process that included a pre-rinse cycle, a wash cycle and a rinse cycle. The detergent and rinse aid were both dosed automatically into the washing machine.

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The solutions used were made up to the following concentrations:

- detergent: 50 ml in 50 l of water; and
- rinse aid: 5 ml in 20 l of water.

10 Uniform standard white dinner plates were used for the experiment. The rate of addition of ozone in gaseous phase was 780 mg/hour giving less than 1 ppm concentration and the process of addition of the ozone in gaseous phase into the washing machine during the 6 minute wash cycle was conducted at a rate of 780 mg per hour.

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Bacteria counts were conducted before and after washing, and with and without ozone, the results of which are tabulated below in Tables 1, 2 and 3. The trial achieved a kill rate of 100% of all bacteria detected when using ozone.

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### **Ozone Usage Trial in Warewashing Machines**

#### **Scope of trial**

25 To determine the kill efficacy of ozone on selected bacteria in warewashing machine.

#### **Bacteria used**

- 30
- staphylococcus aureus;
  - escherichia coli;
  - pseudomonas aeruginosa;
  - bacillus subtilis;

- salmonella typhi; and
- listeria monocytogenes,

the above bacteria having been sourced from the following batches obtained  
5 from the South African Bureau of Standards:

- S. aureus (STA 53)
- E.coli (SABS TCC ESC 37)
- P.Aeruginose (PSE 16)
- 10 • B.subtillis (BAC 35)
- Salmonella (SAL 10)
- Listeria (LI 5)

#### Testing Methodology and Tabulated Results

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1. The surface of the plate used to conduct the testing on was swabbed prior to testing, and the plate was washed with commercially available detergent.
- 20 2. The surface of each plate on which testing was to be conducted was divided into two columns with 12 rows each.
3. The column on the left hand side was marked "Before Washing" and the column on the right hand side was marked "After Washing".
- 25 4. Loopfulls of each bacteria culture were placed and suspended into 5 ml separate aliquots of sterile milk, with each such aliquot being tested for the presence of antibiotics. Only those aliquots indicating a negative result for the presence of antibiotics were used in further  
30 experimentation.
5. Each row on each plate was inoculated with solutions of the respective bacteria-types specified above.

6.
- The plates were left to dry in an incubator for 10-15 minutes.
7.
- Each row in the column on the left hand side of the plate marked
- 5
- "Before Washing" was swabbed so as to establish the presence and/or quantities of bacteria present on the ware.

Table 1: Measured Bacteria Counts Before Washing with Ozone

Swab Descript ion	Total Aerobic Count SABS 763	Staph SGS 1TP:01 2	E.coli SGS 1TP:00 4	Pseudomon as spp OXOID 6 <sup>th</sup> EDD (1990)	Bacillus Cereus SGS 1TP:011	Salmonell a spp. 1TO:018	Listeria OXOID 6 <sup>TH</sup> Ed (1990)
Swab 1	0						
Swab 2	0						
Swab 3		>3000					
Swab 4			214.				
Swab 5				Present			
Swab 6					Present		
Swab 7						Present	
Swab 8							0

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8.
- Plates were then washed in the ware washing machine in the presence of ozone, together with a ware washing detergent comprising :

Component	% composition (by mass)
EDTA	4.00
NTA	7.00
Caustic soda lye	40.05
Water (softened)	46.70886
Triton BG-10	0.06615
Triton CF-32	0.08976

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Bayhibit™ AM or Belclene® 650	0.01963
Water (softened)	2.0656

and a rinse aid composition comprising:

Component	% composition (by mass)
Propyl alcohol	40.00
Citric Acid	0.10
Water (softened)	49.40
Synperonic™ LF/RA30	5.50
Synperonic™ LF/RA260	5.00

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9. After the wash cycle was completed, the plates was removed from the ware washer and the right hand side of each row in the "After Washing" column was swabbed so as to determine whether any bacteria was present thereon.

10 Table 2: Measured Bacteria Counts After Washing with Ozone

Swab Descript ion	Total Aerobic Count SABS 763	Staph SGS 1TP:012	E.coli SGS 1TP:004	Pseudomo n as spp OXOID 6 <sup>th</sup> EDD (1990)	Bacillus Cereus SGS 1TP:011	Salmon ella spp. 1TO:01 8	Listeria OXOID 6 <sup>TH</sup> Ed (1990)
Swab 9		None Detected					
Swab 10			None Detected				
Swab 11				None Detected			
Swab 12					None Detected		
Swab						Absent	

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13							
Swab							0
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It will be seen from the above table that no bacteria was found on the ware and thus a 100% kill rate was achieved when using ozone.

5 The above testing methodology was repeated without using Ozone. The results are shown in Table 3, where it can be seen that without using ozone, not all the bacteria was removed.

**Table 3: Measured Bacteria Counts Before and After Washing Without Ozone.**

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	Staph SGS 1TP:012	E.coli SGS 1TP:004	Pseudomon as spp OXOID 6 <sup>th</sup> EDD (1990)	Bacillus Cereus SGS 1TP:011	Salmonell a spp. 1TO:018	Listeria OXOID 6 <sup>TH</sup> Ed (1990)
Measured counts Before wash	2 x 10 <sup>6</sup>	3 x 10 <sup>6</sup>	19 x 10 <sup>6</sup>	2 x 10 <sup>6</sup>	4 x 10 <sup>6</sup>	500
Measured counts After wash	1200	4600	12200	1370	2040	20

**Example 2: Description of the Cycles in a Preferred Cold Warewashing Process**

15 The ware washing process used in the evaluation of the efficacy of ozone as a biocide in ware washers was a 6 minute cycle which included a pre-rinse cycle, wash cycle and rinse cycle. Both the detergent as well as the rinse aid (as described above) were automatically dosed into the ware washer at a rate of 50 mℓ per 20 ℓ water for the detergent and 25 mℓ per 20ℓ water for rinse  
20 aid. The ozone was dosed into the ware washer in a gaseous phase at a rate of 780 mg per hour. The ozone generating unit was designed to commence

dispensing ozone into the ware washer on activation of the ware washer, and to cease operation when the washing cycle had been completed.

5 **Example 3: Relative Performance Evaluation: Variable Rates of Introduction of Ozone into the Washing Machine**

10 The experimental procedure as described in Example 1 were repeated, varying only the rate of addition of ozone into the ware washer from 500 mg per hour to 900 mg per hour. Consideration and comparison of the results obtained revealed that the optimum was found at 780 mg per hour.

15 It is worth noting that the bacterial load used in the experimental tests conducted were exceedingly high and such loads would not normally be found in practice and therefore the ozone value could be reduced significantly.

The optimum dosages for the detergent and rinse aid were found, similarly, to be 50 ml per 20 l water and 25 ml per 25 l water respectively, although this could vary substantially depending on the degree of soiling and also bacterial load.

20 It will be appreciated that numerous embodiments of the invention may be performed without departing from the scope and spirit of the invention as claimed.